The documentation and process conversion measures necessary to comply with this revision shall be completed by 10 December 2003.

INCH-POUND

MIL-PRF-19500/533F
10 September 2003
SUPERSEDING
MIL-PRF-19500/533E
20 September 1999

PERFORMANCE SPECIFICATION

* SEMICONDUCTOR DEVICE, DIODE, SILICON, VOLTAGE REGULATOR
TYPES 1N6309 THROUGH 1N6355; 1N6309US THROUGH 1N6336US;
PLUS C AND D TOLERANCE SUFFIX,
JAN, JANTX, JANTXV, AND JANS

This specification is approved for use by all Departments
and Agencies of the Department of Defense.

1. SCOPE

* 1.1 Scope. This specification covers the performance requirements for microminiature 500 mW, silicon, metallurgically bonded, voltage regulator diodes with voltage tolerances of 5 percent, 2 percent, and 1 percent. Four levels of product assurance are provided for each encapsulated device type as specified in MIL-PRF-19500.

1.2 Physical dimensions. See figure 1 (DO-35) and figure 2 (surface mount).

* 1.3 Maximum ratings. Maximum ratings are as shown in maximum and primary test ratings (see 3.11) herein and as follows:

a. $P_T$ = 500 mW (D0-35) at $T_L$ = + 75°C, L = .375 inch (9.53 mm); both ends of case or diode body to heat sink at L = .375 inch (9.53 mm). (Derate $I_Z$ to 0.0 mA dc at +175°C).

b. $P_T$ = 500 mW (surface mount) at $T_{EC}$ = 125°C. (Derate to 0 at 175°C).

c. 65°C ≤ $T_J$ ≤ +175°C; -65°C ≤ $T_{STG}$ ≤ +175°C.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Defense Supply Center, Columbus, ATTN: DSCC/VAC, Post Office Box 3990, Columbus, OH 43216-5000, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 5961

* 1.4 Primary electrical characteristics. Primary electrical characteristic are shown in maximum and primary test ratings (see 3.11) herein and as follows:

a. 2.4 V dc ≤ $V_Z$ ≤ 200 V dc (nominal).

b. 1N6309D through 1N6355D are 1 percent voltage tolerance.

c. 1N6309C through 1N6355C are 2 percent voltage tolerance.

d. 1N6309 through 1N6355 are 5 percent voltage tolerance.

e. $R_{\theta JL}$ = 200°C/W (maximum) at L = .375 inch (9.53 mm) (D0-35) non-surface mount.

f. $R_{\theta JL}$ = 50°C/W (maximum) at L = 0 inch non-surface mount.

g. $R_{\theta JEC}$ (end-cap) = 50°C/W (maximum) surface mount.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATION

DEPARTMENT OF DEFENSE

MIL-PRF-19500 - Semiconductor Devices, General Specification for.

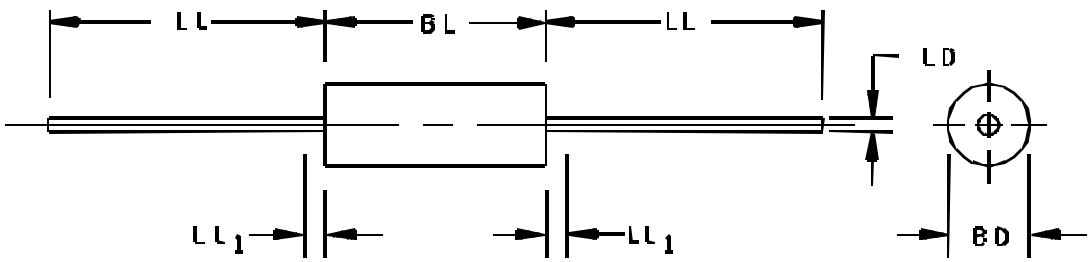
STANDARD

DEPARTMENT OF DEFENSE

MIL-STD-750 - Test Methods for Semiconductor Devices.

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Document Automation and Production Services (DAPS), Building 4D (DPM-DODSSP), 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

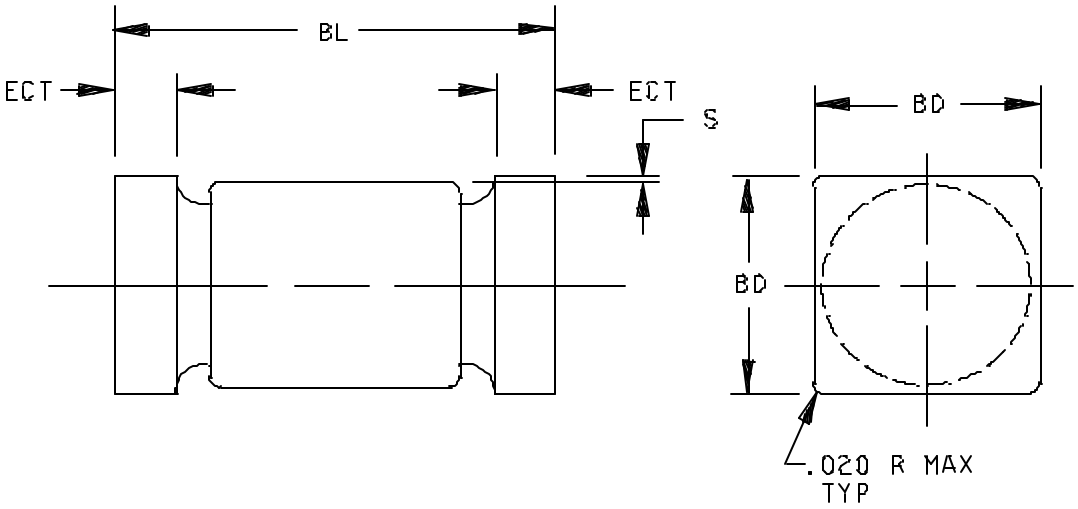
2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.




| Ltr | Dimensions | | | | Notes |
|---|---|---|---|---|---|
| | Inches | | Millimeters | | |
| | Min | Max | Min | Max | |
| BD | .060 | .090 | 1.52 | 2.29 | |
| BL | .120 | .200 | 3.05 | 5.08 | |
| LD | .018 | .022 | 0.46 | 0.56 | |
| LL | 1.000 | 1.500 | 25.40 | 38.10 | |
| $LL_1$ | | .050 | | 1.27 | 3 |

* NOTES:
1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Lead diameter not controlled in this zone to allow for flash. Lead finish build-up and minor irregularities other than slugs.
4. Dimensions are in accordance with ASME Y14.5M.

FIGURE 1. Physical dimensions (DO-35).




| Symbol | Dimensions | | | |
|---|---|---|---|---|
| | Inches | | Millimeters | |
| | Min | Max | Min | Max |
| BD | .070 | .096 | 1.78 | 2.16 |
| ECT | .019 | .028 | 0.48 | 0.71 |
| BL | .165 | .195 | 4.19 | 4.95 |
| S | .003 min | | 0.08 min | |

NOTES:
1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. In accordance with ASME Y14.5M, diameters are equivalent to ϕx symbology.

FIGURE 2. Physical dimensions surface mount device, "US".

3. REQUIREMENTS

* 3.1 General. The individual item requirements shall be as specified in MIL-PRF-19500 and as modified herein.

3.2 Qualification. Devices furnished under this specification shall be products that are manufactured by a manufacturer authorized by the qualifying activity for listing on the applicable qualified manufacturer's list (QML) before contract award (see 4.2 and 6.3).

3.3 Abbreviations, symbols, and definitions. Abbreviations, symbols, and definitions used herein shall be as specified in MIL-PRF-19500 and as follows.

C .....2 percent voltage tolerance.
D .....1 percent voltage tolerance.
EC .....End-cap.
$T_{EC}$ .....Temperature of end-cap.
US .....Unleaded square end-cap.

3.4 Interface and physical dimensions. Interface and physical dimensions shall be as specified in MIL-PRF-19500 and on figure 1 (DO - 35) and figure 2 (surface mount) herein.

* 3.5 Construction. All devices shall be metallurgically bonded, thermally matched, non-cavity, double-plug construction in accordance with MIL-PRF-19500.

3.5.1 Metalurgical bond for diodes with $V_Z$ greater than 6.8 V dc. Category I bonds as defined in accordance with MIL-PRF-19500 shall be utilized.

3.5.2 Metalurgical bond for diodes with $V_Z$ less than or equal to 6.8 V dc. Category I or category III bonds as defined in accordance with MIL-PRF-19500 shall be utilized.

3.6 Marking. Marking shall be in accordance with MIL-PRF-19500.

3.6.1 Marking of US version devices. Marking of US devices shall be in accordance with MIL-PRF-19500.

3.6.2 Polarity. The polarity shall be indicated with a contrasting color band to denote the cathode end. Alternately, for surface mount (US) devices, a minimum of three evenly spaced contrasting color dots around the periphery of the cathode end may be used. No color coding will be permitted.

3.7 Lead finish. Lead finish shall be solderable as defined in MIL-PRF-19500, MIL-STD-750, and herein. Where a choice of lead finish is desired, it shall be specified in the acquisition document (see 6.2).

3.8 Selection of tight tolerance devices. The C and D suffix devices shall be selected from JAN, JANTX, JANTXV, and JANS devices which have successfully completed all applicable screening, and tables I, II and III testing as 5 percent tolerance devices. All sublots of C and D suffix devices shall pass table I, subgroup 2, at tightened tolerances. Tighter tolerances for mounting clip temperature shall be maintained for reference purposes to establish correlation. For C and D tolerance levels, $T_L$ = 25°C, +1°C, -3°C at .375 inch (9.53 mm) from body or equivalent.

3.9 Electrical performance characteristics. Unless otherwise specified herein, the electrical performance characteristics are as specified in 1.3, 1.4, and table I herein.

3.10 Electrical test requirements. The electrical test requirements shall be the subgroups specified in table I and II herein.

* 3.11 Maximum and primary test ratings. Maximum and primary test ratings for voltage regulator diodes are specified in table III herein.

3.12 Workmanship. Semiconductor devices shall be processed in such a manner as to be uniform in quality and shall be free from other defects that will affect life, serviceability, or appearance.

4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

a. Qualification inspection (see 4.2).

b. Screening (see 4.3).

c. Conformance inspection (see 4.4).

4.1.1 Lot accumulation. Lot accumulation period shall be 3-months in lieu of 6-weeks.

4.2 Qualification inspection. Qualification inspection shall be in accordance with MIL-PRF-19500 and herein.

4.2.1 Group E qualification. Group E qualification shall be performed herein for qualification or requalification only. In case qualification was awarded to a prior revision of the associated specification that did not request the performance of table II tests, the tests specified in table II herein shall be performed on the first inspection lot to this revision to maintain qualification.

4.3 Screening (JANTX, JANTXV, and JANS levels only). Screening shall be in accordance with table IV of MIL-PRF-19500, and as specified herein. The following measurements shall be made in accordance with table I herein. Devices that exceed the limits of table I herein shall not be acceptable.

| Screen (see table IV of MIL-PRF-19500) | Measurement | |
|---|---|---|
| | JANS level | JANTXV and JANTX level |
| 1a<br>1b | Required<br>Required | Not required<br>Required (JANTXV only) |
| 2 | Not required | Not required |
| 3a<br>3b<br>(1) 3c | Required<br>Not applicable<br>Required (see 4.3.1) | Required<br>Not applicable<br>Required (see 4.3.1) |
| 4, 5, 6 and 7a | Not applicable | Not applicable |
| 7b | Required | Required |
| 8 | Required | Not required |
| 9 | Required on Nom $V_Z > 10$ V<br>$I_{R1}$ $V_{Z2}$ and $Z_Z$ | Not applicable |
| 10 | Required on Nom $V_Z > 10$ V | Not applicable |
| 11 | Required<br>$I_{R1}$ $V_{Z2}$; $\Delta I_{R1} \leq 100$ percent of value or 50 nA dc, whichever is greater. $\Delta V_{Z2} \leq \pm 1$ percent of initial value. | Required<br>$I_{R1}$ and $V_{Z2}$ |
| 12 | Required, see 4.3.2 | See 4.3.2 |
| (2) 13 | Required<br>Scope display, see 4.5.9<br>Subgroup 2 and 3 of table I herein; $\Delta I_{R1} \leq$ 100 percent of initial reading or 50 nA whichever is greater; $\Delta V_{Z2} \leq 1$ percent of initial reading. | Subgroup 2 of table I herein; $\Delta I_{R1} \leq 100$ percent of initial reading or 50 nA whichever is greater; $\Delta V_{Z2} \leq 1$ percent of initial reading. |
| 14a<br>14b | Not applicable<br>Optional | Not applicable<br>Optional |
| 15 | Required | Not required |
| 16 | Required | Not required |
| 17 | Not required | Not required |

(1) Thermal impedance may be performed any time after sealing provided temperature cycling is performed in accordance with MIL-PRF-19500, screen 3 prior to this thermal test.

(2) $Z_{\theta JX}$ need not be performed in screen 13, if prior to screen 13.

4.3.1 Thermal impedance ($Z_{\theta JX}$ measurements). The thermal impedance($Z_{\theta JX}$) measurements shall be performed in accordance with method 3101 of MIL-STD-750. The maximum limit for $Z_{\theta JX}$ in screening (table IV of MIL-PRF-19500) shall be developed by the supplier using statistical techniques and shall not exceed the table I, subgroup 2 limit.

* 4.3.2 Power burn-in conditions. Power burn-in conditions are as follows: The test current $I_Z$ shall be adjusted to produce a junction temperature of +125°C minimum and $I_Z$ minimum shall be equal to 50 percent of column 8 of table III (see 4.5.10). Use method 3100 of MIL-STD-750 to measure $T_J$.

4.4 Conformance inspection. Conformance inspection shall be in accordance with MIL-PRF-19500, and as specified herein.

4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with table V of MIL-PRF-19500. End-point electrical measurements shall be in accordance with table I,subgroup 2 herein. The following test conditions shall be used for $Z_{\theta JX}$, group A inspection: $Z_{\theta JX} \leq 15°C/W$.

a. $I_M$ .....1 mA to 10 mA.

b. $I_H$ .....2 A minimum.

c. $t_H$ .....10 ms.

d. $t_{MD}$ .....70 µs maximum.

4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing in table VIa (JANS) and table VIb (JAN, JANTX and JANTXV) of MIL-PRF-19500, and herein. Electrical measurements (end-points) and delta requirements shall be in accordance with table I, subgroup 2 and 4.5.8 herein.

* 4.4.2.1 Group B inspection, table VIa (JANS) of MIL-PRF-19500.

| Subgroup | Method | Condition |
|---|---|---|
| B3 | 1056 | 0°C to +100°C, 10 cycles, n = 22 c = 0. |
| B3 | 1051 | -55°C to +175°C, 20 cycles, n = 22 c = 0. |
| B3 | 4066 | $T_A$ = room ambient as defined in the general requirements of 4.5 of MIL-STD-750. $I_{ZSM}$ = column 9 of table III herein (shall be performed on each sublot). |
| B3 | 1071 | Condition E. |
| B4 | 1037 | $I_Z$ = shall be equal to 100 percent of column 7 of table III minimum, 2,000 cycles. |
| B5 | 1027 | $I_Z$ = 50 percent of column 7 of table III minimum for 96 hours; Adjust $T_A$ and / or $I_Z$ to achieve $T_J$ minimum. |
| | | Option 1: $T_A$ = +100°C max; $T_J$ = +275°C minimum; t = 96 hours. n =22, c = 0. |
| | or | Option 2: $T_A$ = +30°C max; $T_J$ = +175°C minimum; t = 1,000 hours n = 45, c = 0. |

4.4.2.2 Group B inspection, table VIb (JAN, JANTX, and JANTXV) of MIL-PRF-19500.

| | Subgroup | Method | Condition |
|---|---|---|---|
| | B2 | 1056 | 0°C to +100°C, 10 cycles, n = 22 c = 0. |
| * | B2 | 1051 | -55°C to +175°C, 20 cycles, n = 22 c = 0. |
| | B2 | 1071 | Condition E. |
| * | B3 | 1027 | $I_Z$ (min) shall be equal to 50 percent of column 7 of table III minimum. Adjust $I_Z$ to achieve $T_J$ = 150°C minimum (see 4.5.10). |

4.4.3 Group C inspection. Group C inspection shall be conducted in accordance with the conditions specified for subgroup testing in table VII of MIL-PRF-19500 and as follows. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein.

| Subgroup | Method | Condition |
|---|---|---|
| C2 | 1056 | 0°C to +100°C, 10 cycles, n = 22 c = 0. |
| C2 | 2036 | Condition A; 4 pounds; t = 15 seconds ±3 s (not applicable to "US" suffix devices).<br><br>Condition E, 8 ounces, t = 15 seconds ±3 s (not applicable to "US" suffix devices). |
| C3 | 1071 | Condition E. |
| C6 | 1027 | $I_Z$ (min) shall be equal to 50 percent of column 7 of table III minimum. Adjust $I_Z$ to achieve $T_J$ = 150°C minimum (see 4.5.1). |
| C5 | 3101<br>or<br>4081 | $R_{\theta JL}$ = 200°C/W (max) at L = .375 inch (9.53 mm);<br>$R_{\theta JEC}$ = 50°C/W (max) for US types. n = 22, c = 0 (see 4.5.8). |
| C7 | | Not applicable |
| C8 | 4071 | (For JAN, JANTX and JANTXV only); $I_{Z2}$ = column 4 of table III; $T_1$ = +25°C ± 5°C, $T_2$ = +125°C (see 4.5.5); $\alpha V_Z$ = Col. 15 of table III; n = 22 devices, c = 0. |

4.4.4 Group E inspection. Group E inspection shall be conducted in accordance with the conditions specified for subgroup testing in table IX of MIL-PRF-19500 and as specified in table II herein. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein. See 4.5.8 for delta limits when applicable.

4.5 Methods of inspection. Methods of inspection shall be as specified in the appropriate tables and as follows:

4.5.1 Pulse measurements. Conditions for pulse measurement shall be as specified in section 4 of MIL-STD-750.

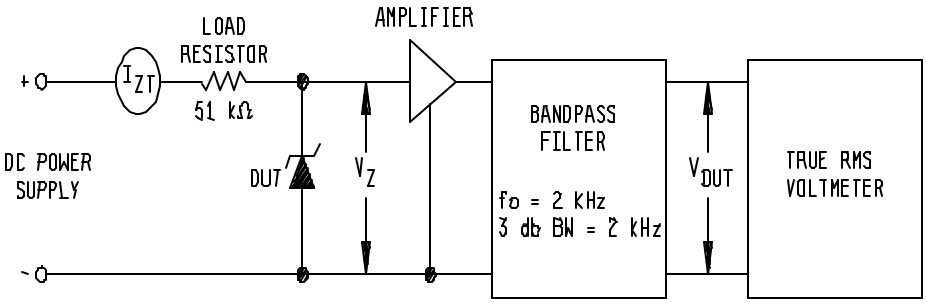
4.5.2 Surge current ($I_{ZSM}$). The peak currents shown in column 9 of table III shall be applied in the reverse direction and these shall be superimposed on the current ($I_Z$ = column 4 of table III); a total of 5 surges at 1 minute intervals. Each individual surge shall be 0.5 -square-wave-pulse of 8.3 ms duration or an equivalent sine wave with the same effective rms current.

4.5.3 Regulator voltage measurements. The test current shall be applied until thermal equilibrium is attained (90 ±2 seconds minimum) prior to reading the breakdown voltage. For this test, the diode shall be suspended by its leads with mounting clips whose inside edge is located at .375 inch (9.53 mm) from the body and the mounting clips shall be maintained at a temperature of +25°C +8°C, -2°C. US suffix devices shall be mounted at the end caps. This measurement may be performed after a shorter time following application of the test current than that which provides thermal equilibrium if correlation to stabilized readings can be established to the satisfaction of the qualifying activity.

4.5.4 Voltage regulation. For values of $V_{Z2}$ (nominal) from 6.8 V dc to 200 V dc, current at 10 percent of $I_{ZM}$ (column 7 of table III) shall be maintained for a period of 90 ±5 seconds, and then $V_Z$ shall be recorded. The current shall then be increased to 50 percent of $I_{ZM}$ (column 7 of table III) and maintained for a period of 90 ±5 seconds, and then $V_Z$ shall be recorded. The voltage change shall not exceed the applicable limits as shown in, column 8 of table III. During this test, the diode shall be suspended by its leads with mounting clips whose inside edge is located between .375 inch (9.53 mm) and .500 inch (12.70 mm) from the device body and the mounting clips shall be maintained at a temperature of + 25°C + 8°C, -2°C. US suffix devices shall be mounted by the end-caps. For values of $V_{Z2}$ (nominal) from 2.4 V dc to 6.2 V dc, the lower test current shall be 2 mA dc and the higher current shall be 20 mA dc.

4.5.5 Temperature coefficient of regulator voltage ($\alpha V_Z$). The device shall be temperature stabilized with current applied prior to reading regulator voltage at the specified ambient temperature.

4.5.6 Noise density. Noise density shall be measured using a noise density test circuit as shown on figure 3. Place a low-noise resistor, equivalent in value to the dynamic impedance of the diode under test, in the test clips and adjust test current ($I_{ZT}$) to 250 µA dc and measure output-noise voltage. Remove the resistor, insert diode under test in test clips, readjust test current to 250 µA dc and measure output-noise voltage again. To obtain noise density ($N_D$), subtract rms resistor output-noise voltage from rms diode output-noise voltage and divide by product of overall system gain and square root of bandwidth. All measurements shall be made at +25°C.




NOTES:

1. Input voltage and lead resistance should be high so that zener can be driven from a constant current source.
2. Input impedance of band pass filter should be high compared with the dynamic impedance of the diode under test.
3. Filter bandwidth characteristics shall be as follows:
   a. $f_o$ = 2,000 Hz.
   b. Shape factor, -40 db to -3 db, approximately 2.
   c. Passband at the -3 db is 1,000 Hz ±50 Hz to 3,000 Hz ±250 Hz.
   d. Passband at the -40 db is 500 Hz ± 50 Hz to 6,000 Hz ±600 Hz.

FIGURE 3. Circuit for determination of noise density.

4.5.7 Thermal resistance. Thermal resistance measurement shall be in accordance with methods 3101 or 4081 of MIL-STD-750. Read and record data in accordance with group E herein shall be included in the qualification report. Forced moving air or draft shall not be permitted across the device during test. The maximum limit for $R_{\theta JL}$ under these test conditions shall be $R_{\theta JL}$ (max) = 200°C/W, for surface mount $R_{\theta JEC}$ = 50°C/W. The following conditions shall apply:

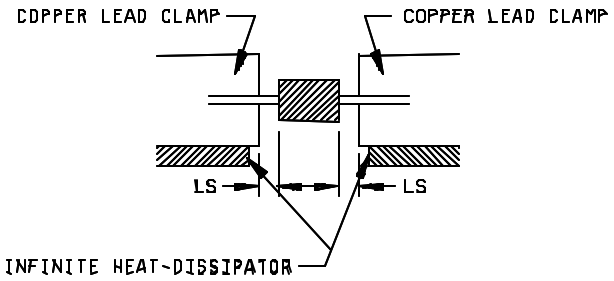
a. $I_M$ ..... 1 mA to 10 mA.

b. $I_H$ ..... 200 mA to 400 mA.

c. $t_H$ ..... 25 seconds minimum.

d. $t_{MD}$ ..... 70 µs maximum.

LS = lead spacing = .375 inch (9.53 mm) for non-surface mount devices and 0 inch for surface mount devices as defined on figure 4 below:




NOTES:

1. The lead temperature, $T_L$ shall be measured on a lead at a point adjacent to the heat sink clamp (reference point).
2. The clamping force on each lead shall be 4 ± 0.5 pounds.
3. The device under test (DUT) shall be shielded from drafts.
4. The heat sink clamps shall be placed equal distance from each end of the diode body.
5. For surface mount devices, the end caps shall be clamped to the heat sinks.

FIGURE 4. Mounting conditions.

4.5.8 Delta requirements. Delta requirements shall be as specified below: (1) (2) (3)

| Step | Inspection | MIL-STD-750 | | Symbol | Limit (1) | Unit |
|---|---|---|---|---|---|---|
| | | Method | Conditions | | | |
| 1. | Regulator voltage | 4022 | $I_Z$ = column 4 of table III (see 4.5.3). | $\Delta V_{Z2}$ | ±1 percent of initial value. | |
| 2. | Reverse current | 4016 | DC method, $V_R$ = column 10 of table III. | $\Delta I_{R1}$ | 100 percent of initial value or 50 nA dc, whichever is greater. | |
| 3. | Small-signal breakdown impedance | 4051 | $I_Z$ = column 4 of table III, $I_{SIG}$ = 10 percent of $I_Z$. | $\Delta Z_Z$ | ±35 percent of initial value or 2 ohms, whichever is greater. | |

(1) Column references are to table II herein.
(2) The delta measurements for table VIa (JANS) of MIL-PRF-19500 are as follows:
    a. Subgroup 4, steps 1, 2 and 3.
    b. Subgroup 5, steps 1, 2 and 3.
(3) The delta measurements for table VIb (JAN, JANTX, and JANTXV) of MIL-PRF-19500 are as follows:
    a. Subgroup 3, step 1.

* 4.5.9 Scope display evaluation. Scope display evaluation shall be stable in accordance with method 4023 of MIL-STD-750, condition A. Scope display may be performed on ATE (automatic test equipment) for screening only with the approval of the qualifying activity. Scope display in table I, subgroup 4 shall be performed on a scope. The reverse current over the knee shall be 500 µA peak.

* 4.5.9.1 Scope display option. At the suppliers option, 100 percent scope display evaluation may be discontinued after three consecutive lots are 100 percent tested with zero failures. Any table I failure shall require 100 percent scope display to be reinvoked.

* 4.5.10 Free air burn-in. Deliberate heat sinking or forced air-cooling is prohibited unless otherwise approved by the qualifying activity. Ambient temperature shall be controlled to prevent $T_J$ from exceeding rated $T_J$. The use of a current limiting or ballast resistor is permitted provided that each DUT still sees the full $P_t$ (minimum) and that the minimum applied voltage, where applicable, is maintained through out the burn-in period.

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TABLE I. Group A inspection.

| Inspection 1/ | MIL-STD-750 | | Symbol | Limits 2/ | | Unit |
|---|---|---|---|---|---|---|
| | Method | Conditions | | Min | Max | |
| Subgroup 1 | | | | | | |
| Visual and mechanical examination | 2071 | | | | | |
| Subgroup 2 | | | | | | |
| Thermal impedance | 3101 | See 4.3.1 | $Z_{\theta JX}$ | | 15 | °C/W |
| Forward voltage | 4011 | $I_F$ = 1 A dc, pulsed (see 4.5.1). | $V_F$ | | 1.4 | V dc |
| Reverse current leakage | 4016 | DC method; $V_R$ = column 10 of table III. | $I_{R1}$ | | Column 11 | µA dc |
| Regulator voltage (see 4.5.3) | 4022 | $I_{Z1}$ = 250 µA dc. | $V_{Z1}$ | Column 3 | | V dc |
| Regulator voltage (see 4.5.3) | 4022 | $I_{Z2}$ = column 4 of table III. | $V_{Z2}$ | Column 2 -5, -2, -1 percent | Column 2 +5, +2, 1 percent | V dc |
| Subgroup 3 | | | | | | |
| High-temperature operation | | $T_A$ = +150°C | | | | |
| Reverse current | 4016 | DC method; $V_R$ = column 10 of table III. | $I_{R2}$ | | Column 12 | µA dc |
| Subgroup 4 | | | | | | |
| Small-signal reverse breakdown impedance | 4051 | $I_Z$ = column 4 of table III, $I_{SIG}$ = 10 percent of $I_{Z2}$. | $Z_Z$ | | Column 5 | ohms |
| Knee impedance | 4051 | $I_{ZK}$ = 250 µA dc, $I_{SIG}$ = 25 µA rms | $Z_{ZK}$ | | Column 6 | ohms |
| Noise density (see 4.5.6) | | $I_{Z1}$ = 250 µA dc | $N_D$ | | Column 14 | $\mu V/\sqrt{Hz}$ |

See footnotes at end of table.

TABLE I. Group A inspection - Continued.

| Inspection 1/ | MIL-STD-750 | | Symbol | Limits 2/ | | Unit |
|---|---|---|---|---|---|---|
| | Method | Conditions | | Min | Max | |
| Subgroup 4 - continued | | | | | | |
| Scope display evaluation | 4023 | See 4.5.9<br>n = 116, c = 0 | | | | |
| Subgroup 5 | | | | | | |
| Not applicable | | | | | | |
| Subgroup 6 | | | | | | |
| Surge current | 4066 | $T_A$ = +25°C ± 5°C (see 4.5.2); $I_{ZSM}$ = column 9 of table III herein (shall be performed on each sublot). | | | | |
| Electrical measurements | | See table I, subgroup 2 herein. | | | | |
| Subgroup 7 | | | | | | |
| Not applicable | | | | | | |
| Subgroup 8 | | Sampling plan 22 devices, c = 0 | | | | |
| Voltage regulation | | See 4.5.4 | $V_{Z(reg)}$ | | Column 8 | V dc |
| Temperature coefficient of regulator voltage | 4071 | JANS level,<br>$I_Z$ = column 4 of table III,<br>$T_1$ = +25°C ± 5°C;<br>$T_2$ = +125°C (see 4.5.5) | $\alpha V_Z$ | | Column 15 | %/°C |

1/ For sampling plan, see MIL-PRF-19500.
2/ Column references are to table III herein.

* TABLE II. Group E inspection (all quality levels).

| Inspection | MIL-STD-750 | | Sampling plan |
|---|---|---|---|
| | Method | Conditions | |
| Subgroup 1 | | | 22 devices c = 0 |
| Temperature cycling | 1056 | 20 cycles, condition D except low temperature shall be achieved using liquid nitrogen (-195°C). Do a visual for cracked glass. | |
| Electrical measurements | | See table I, subgroup 2 | |
| Subgroup 2 | | | 22 devices c = 0 |
| Intermittent operating life | 1037 | $I_Z = I_{Z2}$ (column 8 of table III) at $T_A$ = room ambient for 10,000 cycles. No forced air cooling on the device shall be permitted. (Mounting conditions in accordance with 4.5.7). | |
| Electrical measurements | | See table I, subgroup 2 | |
| Subgroup 3 | | | 3 devices, c = 0 |
| DPA | 2101 | Cross section or scribe and break. | |
| Subgroup 4 | | | 22 devices c = 0 |
| Thermal impedance curves | 3101 or 4081 | Each supplier shall submit their (typical) design thermal impedance curves. In addition, test conditions and $Z_{\theta JX}$ limit shall be provided to the qualifying activity in the qualification report. | |
| Subgroups 5 and 6 | | | |
| Not applicable | | | |
| Subgroup 7 | | | n = 45 |
| Resistance to glass cracking | 1057 | Step stress to destruction by increased cycles or up to a maximum of 25 cycles. | |
| Subgroup 8 | | | n = 45, c = 0 |
| Soldering heat | 2031 | One cycle. | |

TABLE III. Characteristics and ratings.

| Col 1 | Col 2 | Col 3 | Col 4 | Col 5 | Col 6 | Col 7 | Col 8 | Col 9 | Col 10 | Col 11 | Col 12 | Col 13 | Col 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Type | $V_{Z2}$ nom at $I_{Z2}$ 1/ | $V_{Z1}$ min at $I_{Z1}$ 250 µA | $I_{Z2}$ test current | $Z_Z$ at $I_{Z2}$ | $Z_{ZK}$ at 250 µA | $I_Z$ | $V_{Z(reg)}$ | $I_{ZSM}$ surge | $V_R$ | $I_{R1}$ at +25°C | $I_{R2}$ at $T_A$ = +150°C | $N_D$ at 250 µA 1-3 kHz | $\alpha_{vz}$ |
| | V | V | mA | Ω | Ω | mA | V | A | V | µA | µA | $\mu v\sqrt{Hz}$ | %/°C |
| 1N6309 | 2.4 | 1.1 | 20 | 30 | 1,200 | 177 | 1.50 | 2.50 | 1.0 | 100 | 200 | 1 | -.085 |
| 1N6310 | 2.7 | 1.2 | 20 | 30 | 1,300 | 157 | 1.50 | 2.20 | 1.0 | 60 | 150 | 1 | -.080 |
| 1N6311 | 3.0 | 1.3 | 20 | 29 | 1,400 | 141 | 1.50 | 2.00 | 1.0 | 30 | 100 | 1 | -.075 |
| 1N6312 | 3.3 | 1.5 | 20 | 24 | 1,400 | 128 | 1.60 | 1.80 | 1.0 | 5 | 20 | 1 | -.070 |
| 1N6313 | 3.6 | 1.8 | 20 | 22 | 1,400 | 117 | 1.60 | 1.65 | 1.0 | 3 | 12 | 1 | -.065 |
| 1N6314 | 3.9 | 2.0 | 20 | 20 | 1,700 | 108 | 1.60 | 1.50 | 1.0 | 2 | 12 | 1 | -.060 |
| 1N6315 | 4.3 | 2.4 | 20 | 18 | 1,700 | 99 | 0.90 | 1.40 | 1.0 | 2 | 12 | 1 | -.045 +.020 |
| 1N6316 | 4.7 | 2.8 | 20 | 16 | 1,500 | 90 | 0.50 | 1.27 | 1.5 | 5 | 12 | 1 | -.028 +.032 |
| 1N6317 | 5.1 | 3.3 | 20 | 14 | 1,300 | 83 | 0.40 | 1.17 | 2.0 | 5 | 12 | 1 | -.020 +.035 |
| 1N6318 | 5.6 | 4.3 | 20 | 8 | 1,200 | 76 | 0.40 | 1.10 | 2.5 | 5 | 10 | 2 | +.050 |
| 1N6319 | 6.2 | 5.2 | 20 | 3 | 800 | 68 | 0.30 | 0.97 | 3.5 | 5 | 10 | 5 | +.060 |
| 1N6320 | 6.8 | 6.0 | 20 | 3 | 400 | 63 | 0.35 | 1.23 | 4.0 | 2 | 50 | 5 | +.062 |
| 1N6321 | 7.5 | 6.6 | 20 | 4 | 400 | 57 | 0.40 | 1.16 | 5.0 | 2 | 30 | 5 | +.068 |
| 1N6322 | 8.2 | 7.5 | 20 | 5 | 400 | 52 | 0.40 | 1.07 | 6.0 | 1 | 10 | 20 | +.075 |
| 1N6323 | 9.1 | 8.4 | 20 | 6 | 500 | 47 | 0.50 | 0.97 | 7.0 | 1.00 | 10 | 40 | +.076 |
| 1N6324 | 10.0 | 9.1 | 20 | 6 | 500 | 43 | 0.50 | 0.89 | 8.0 | 1.00 | 10 | 80 | +.079 |
| 1N6325 | 11.0 | 10.0 | 20 | 7 | 550 | 39 | 0.50 | .083 | 8.5 | 1.00 | 10 | 100 | +.082 |
| 1N6326 | 12.0 | 11.0 | 20 | 7 | 550 | 35 | 0.55 | 0.77 | 9.0 | 1.00 | 10 | 100 | +.083 |
| 1N6327 | 13.0 | 11.9 | 9.5 | 8 | 550 | 33 | 0.55 | 0.71 | 9.9 | 0.05 | 10 | 100 | +.079 |
| 1N6328 | 15.0 | 13.8 | 8.5 | 10 | 600 | 28 | 0.70 | 0.62 | 11.0 | 0.05 | 10 | 100 | +.082 |
| 1N6329 | 16.0 | 14.7 | 7.8 | 12 | 600 | 27 | 0.75 | 0.58 | 12.0 | 0.05 | 10 | 100 | +.083 |
| 1N6330 | 18.0 | 16.6 | 7.0 | 14 | 600 | 24 | 0.85 | 0.52 | 14.0 | 0.05 | 10 | 100 | +.085 |
| 1N6331 | 20.0 | 18.5 | 6.2 | 18 | 500 | 21 | 0.95 | 0.47 | 15.0 | 0.05 | 10 | 100 | +.086 |
| 1N6332 | 22.0 | 20.4 | 5.6 | 20 | 500 | 19 | 1.05 | 0.43 | 17.0 | 0.05 | 10 | 100 | +.087 |
| 1N6333 | 24.0 | 22.3 | 5.2 | 24 | 500 | 18 | 1.15 | 0.39 | 18.0 | 0.05 | 10 | 100 | +.088 |
| 1N6334 | 27.0 | 25.2 | 4.6 | 27 | 500 | 16 | 1.30 | 0.35 | 21.0 | 0.05 | 10 | 100 | +.090 |
| 1N6335 | 30.0 | 28.0 | 4.2 | 32 | 500 | 14 | 1.45 | 0.31 | 23.0 | 0.05 | 10 | 100 | +.091 |
| 1N6336 | 33.0 | 30.9 | 3.8 | 40 | 600 | 13 | 1.60 | 0.28 | 25.0 | 0.05 | 10 | 100 | +.092 |
| 1N6337 | 36.0 | 33.7 | 3.4 | 50 | 600 | 12.0 | 1.75 | 0.260 | 27.0 | 0.05 | 10 | 100 | +.093 |
| 1N6338 | 39.0 | 36.6 | 3.2 | 55 | 700 | 11.0 | 1.90 | 0.240 | 30 | 0.05 | 10 | 100 | +.094 |
| 1N6339 | 43.0 | 40.4 | 3.0 | 65 | 800 | 9.9 | 2.10 | 0.220 | 33 | 0.05 | 10 | 80 | +.095 |
| 1N6340 | 47.0 | 44.2 | 2.7 | 75 | 900 | 9.0 | 2.25 | 0.200 | 36 | 0.05 | 10 | 80 | +.095 |

See footnote at end of table.

TABLE III. Characteristics and ratings - Continued.

| Col 1 | Col 2 | Col 3 | Col 4 | Col 5 | Col 6 | Col 7 | Col 8 | Col 9 | Col 10 | Col 11 | Col 12 | Col 13 | Col 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Type | $V_{Z2}$ nom at $I_{Z2}$ 1/ | $V_{Z1}$ min at $I_{Z1}$ 250 µA | $I_{Z2}$ test current | $Z_Z$ at $I_{Z2}$ | $Z_{ZK}$ at 250 µA | $I_Z$ | $V_{Z(reg)}$ | $I_{ZSM}$ Surge | $V_R$ | $I_{R1}$ at +25°C | $I_{R2}$ at $T_A$ = +150°C | $N_D$ at 250 µA 1-3 kHz | $\alpha_{vz}$ |
| | V | V | mA | Ω | Ω | mA | V | A | V | µA | µA | $\mu v\sqrt{Hz}$ | %/°C |
| 1N6341 | 51.0 | 48.0 | 2.5 | 85 | 1,000 | 8.3 | 2.50 | 0.180 | 39 | 0.05 | 10 | 80 | +.096 |
| 1N6342 | 56.0 | 52.7 | 2.2 | 100 | 1,200 | 7.6 | 2.70 | 0.170 | 43 | 0.05 | 10 | 80 | +.097 |
| 1N6343 | 62.0 | 58.4 | 2.0 | 125 | 1,300 | 6.8 | 2.90 | 0.150 | 47 | 0.05 | 10 | 80 | +.097 |
| 1N6344 | 68.0 | 64.1 | 1.8 | 155 | 1,500 | 6.3 | 3.20 | 0.130 | 52 | 0.05 | 10 | 80 | +.098 |
| 1N6345 | 75.0 | 70.8 | 1.7 | 180 | 1,600 | 5.7 | 3.40 | 0.125 | 56 | 0.05 | 10 | 80 | +.098 |
| 1N6346 | 82.0 | 77.4 | 1.5 | 220 | 1,800 | 5.2 | 3.80 | 0.115 | 62 | 0.05 | 10 | 80 | +.099 |
| 1N6347 | 91.0 | 86.0 | 1.4 | 270 | 2,100 | 4.7 | 4.20 | 0.100 | 69 | 0.05 | 10 | 80 | +.099 |
| 1N6348 | 100.0 | 94.5 | 1.3 | 340 | 2,400 | 4.3 | 4.40 | 0.095 | 76 | 0.05 | 10 | 80 | +.110 |
| 1N6349 | 110.0 | 104.0 | 1.1 | 500 | 2,800 | 3.9 | 4.80 | 0.085 | 84 | 0.05 | 10 | 80 | +.110 |
| 1N6350 | 120.0 | 113.0 | 1.0 | 600 | 3,200 | 3.5 | 5.20 | 0.080 | 91 | 0.05 | 10 | 80 | +.110 |
| 1N6351 | 130.0 | 122 | 0.95 | 850 | 4,100 | 3.3 | 5.60 | 0.070 | 99 | 0.05 | 10 | 80 | +.110 |
| 1N6352 | 150.0 | 141 | 0.85 | 1,000 | 4,500 | 2.8 | 7.00 | 0.065 | 114 | 0.05 | 10 | 80 | +.110 |
| 1N6353 | 160.0 | 151 | 0.80 | 1,200 | 5,000 | 2.7 | 7.50 | 0.060 | 122 | 0.05 | 10 | 80 | +.110 |
| 1N6354 | 180.0 | 170 | 0.68 | 1,500 | 5,600 | 2.4 | 9.00 | 0.050 | 137 | 0.05 | 10 | 80 | +.110 |
| 1N6355 | 200.0 | 189 | 0.65 | 1,800 | 6,500 | 2.1 | 12.00 | 0.045 | 152 | 0.05 | 10 | 80 | +.110 |

1/ 1N6309D through 1N6355D are 1 percent voltage tolerance. 1N6309C through 1N6355C are 2 percent voltage tolerance. 1N6309 through 1N6355 are 5 percent voltage tolerance.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The notes specified in MIL-PRF-19500 are applicable to this specification.

6.2 Acquisition requirements. Acquisition documents must specify the following:

a. Title, number, and date of this specification.

b. Issue of DoDISS to be cited in the solicitation and if required, the specific issue of individual documents referenced (see 2.2.1).

c. Lead finish as specified (see 3.7).

d. Type designation and quality assurance level.

e. Packaging requirements (see 5.1).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Manufacturer's List QML No.19500 whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Defense Supply Center, Columbus, ATTN: DSCC-VQE, P.O. Box 3990, Columbus, OH 43216-5000.

6.4 Substitution information.

6.4.1 Substitutability of 2 percent and 1 percent tolerance devices. Devices of tighter tolerance are a direct one way substitute for the looser tolerance devices (example: JANTX1N6309D-1 substitutes for JANTX1N6309-1).

6.5 Changes from previous issue. The margins of this specification are marked with asterisks to indicate where changes from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

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Air Force - 11
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(Project 5961-2690)

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SEMICONDUCTOR DEVICE, DIODE, SILICON, VOLTAGE REGULATOR TYPES 1N6309 THROUGH 1N6355; 1N6309US THROUGH 1N6336US; PLUS C AND D TOLERANCE SUFFIX, JAN, JANTX, JANTXV, AND JANS

4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

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